DISCUSSIONS

THE IMPROVEMENT OF RURAL WATER SUPPLIES

The article by Dr. E. G. Birge on "The Rural Water Supply an Integral Part of the Municipal Supply," published in the March, 1920, issue of the JOURNAL, presents a number of suggestions which should be of keen interest to all intelligent citizens, and especially to those who are concerned with the protection of the *reputation* as well as the *character* of municipal water supplies.

Under modern conditions man does not—and with wisdom cannot undertake to—live "unto himself alone." Between any two groups of residents in the United States as widely separated as is geographically possible the bonds of connection are many. What is for the good of one community is for the good of all. This is the case with matters general and it is particularly obvious with matters sanitary. Dr. Birge properly emphasizes that health work to safeguard the citizens of a municipality against typhoid fever should be statewide. It may be added that health work to give to the citizens of any of our large municipalities adequate protection against typhoid fever and other communicable diseases must be nation-wide in scope.

A person contracting typhoid fever infection through drinking water from a well or spring polluted with human excreta in a rural district in Maine or California may travel, within the incubation period of the disease, to some large city in the Mississippi valley and there, either before or after the development of definite symptoms of typhoid fever, constitute the source of extensive municipal infection. Though in such instance the infection be spread through the media of food, fingers and flies, the epidemic is likely to excite popular suspicion against the municipal water supply and cause the water works officials serious embarrassment. Many of our large cities obtain their water supplies from rivers or lakes whose sheds drain rural districts in two or more states. The excretal pollution from rural communities of such water courses is a matter of direct concern to those responsible for the wholesomeness of municipal water supplies. The control of the pollution of interstate water courses, to be equitable and adequate, will have to be exercised by some interstate, or national, authority.

In the field of rural sanitation with its vitally important intra and interstate bearing on urban, as well as rural, health, it appears clear that the national government along with the state governments has a definite responsibility and a large opportunity. Since 1914 the U. S. Public Health Service has been engaged in coöperation with state and local health authorities in work for the advancement of rural sanitation. This work has been conducted on as extensive a scale as the remarkably conservative appropriations by Congress for the purpose have made possible. One of the first steps in the work was a complete house-to-house sanitary survey of counties fairly representative of extensive rural districts in different parts of the country—north, east, south and west.

Eighteen counties distributed in sixteen states were surveyed. The findings and the results of the county sanitary surveys are presented in Public Health Bulletin No. 94. At more than 60 per cent of the thousands of farm homes surveyed, the water supplies used for drinking and culinary purposes were found to be obviously, and more or less grossly, polluted with fecal matter. Less than 2 per cent of the sixty-odd thousand country homes visited were equipped with sanitary toilets. Under such conditions in our rural communities generally, it is not surprising that the drift of typhoid fever and other excretal infections is now from the rural district to the city rather than from the city to the rural district, as was the case before the days of extensive installations of adequate municipal water purification systems. From the studies made by the Public Health Service, the important practical conclusion reached was that with a reasonably adequate local health force on the work rural sanitation advancement is feasible. In line with this conclusion, the present program of the Public Health Service is to coöperate with states, counties, townships and municipalities in the development and maintenance of efficient local health organizations to look after the business of public health in rural districts. The purpose of this coöperation is to effect in different parts of the country practical demonstrations of the value of rural health work and thereby to stimulate popular interest toward having state, county, township and municipal governments do their proper parts in the vitally important field of nation-wide rural sanitation.

For the average rural county a health organization to be reasonably adequate should consist of a whole-time health officer, one whole-time health nurse and one whole-time sanitary inspector.

The services of such a country health force can be obtained for about $8,000.00 a year. For the county adopted as a national unit of the coöperative demonstration work in rural health promotion, such a budget may be furnished as follows: $2000 from the U. S. Public Health Service Fund, $2000 from the State Board of Health fund and $4000 from a fund appropriated by the county authorities.

Under the provisions of the Congressional appropriation, the U. S. Public Health Service cannot enter into the demonstration work in a community unless the state, the county, the township or the municipality in which the community is located, separately or together, agree to bear at least one half the expense of the coöperative demonstration work. As a rule more than three-fourths of the expense is met with funds from state and local sources. The head of the demonstration work in the county is appointed by the proper county authorities as county health officer. He is given a status in the state health department, usually that of deputy state health officer. He is also given a status of Field Agent in the U. S. Public Health Service. His qualifications for the position must appear satisfactory to all three coöperating agencies. Thus the county authorities are relieved of any local political embarrassment in declining to appoint one who does not appear qualified, and efficiency of service is promoted. The general plan of the work is agreed upon by authorized representatives of the coöperating agencies. Monthly reports of progress are submitted to the proper offices of the county, the state and the national government. The county is visited from time to time by officers of the State Board of Health and of the U. S. Public Health Service, who inspect the work and advise with the county health officer. The officers detailed for the inspection of the work in the county units are experienced in rural sanitation business and thereby are enabled to give helpful practical suggestions to the heads of local units. Such supervision is obviously advantageous. With the relatively large number of individual property owners who have to see the sense in making the investments before sanitary progress in the rural district can be accomplished, the factors of personal equation are even more important in the rural health force than in the city health force operating under municipal ordinances to carry out mass sanitary measures. The inspecting officers give especial attention to the factors of personal equation, and by presenting the results of the work in the

other demonstration counties stimulate the unit in each county to do its best.

The results of this coöperative demonstration work in rural sanitation have been highly encouraging. In every one of the demonstration counties, marked sanitary improvements have been accomplished within the first few months of operation. Villages and towns replace grossly polluted water supplies with clean water supplies, and grossly insanitary systems of excreta disposal with sanitary systems. In some of the counties radical sanitary improvements with respect to water supplies and excreta disposal have been made at over 50 per cent of the strictly rural houses within the first year of activity of the coöperative health organization. Such sanitary progress in our rural districts means much to the health protection of our rural population and also, as Dr. Birge points out, to the health protection of our urban population.

Work for the prevention of disease and the promotion of health appears to be one of the most logical and, surely, one of the most important functions of democratic government. The sanitary conditions of any locality in the United States have a bearing on the health interests of the locality, of the state and of the nation, and, therefore, should be of concern to the local, the state and the national governments.

The extent to which our governmental agencies will participate in public health business will depend upon popular demand. The critical need for rural sanitation advancement is manifest in all parts of our country—north, east, south and west—including especially our most prosperous states. The urban population has due cause to be concerned seriously about the lack of rural sanitation. Those responsible for the safeguarding of municipal water supplies have especial cause to try to stimulate a reasonable and proper popular demand for much greater activity by governmental and other agencies in the national field of work for rural sanitation advancement.

L. L. Lumsden.[1]

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GROUT AND LEAD WOOL FOR CRACKS IN CONCRETE RESERVOIRS

Referring to the request in the January JOURNAL, for experiences as to methods of stopping leaks due to cracks in the bottom of concrete lined reservoirs, the writer submits the following:

The organizations with which the writer is connected have a number of concrete lined reservoirs, several of which have shown leakage at various times. In no case has the leakage been so great as to constitute a menace to the reservoir and stopping the leakage was attempted entirely as a preventative measure.

The method suggested by D. A. Reed[2] has not been used, owing to the necessity for maintaining a fire in order to heat the asphaltum.

One of the most successful methods has been to open the crack by chipping and placing sections of $1\frac{1}{2}$ inch pipe at proper intervals. The crack between the pipes is filled with a rich, strong grout and, after this has thoroughly set, neat cement grout is pumped through the pipes to refusal, taking care that the pressure does not approach that which would blow out the grout placed in the crack or lift the concrete. A small, ball-valve, hand pump, such as is used for spraying fruit trees, has been used very satisfactorily for this purpose.

Where the cracks are very small and there is not much current in the reservoir, excellent results have been secured by inducing coagulation in these cracks. In several cases where the water was turbid, alum, sown broadcast, has been sufficient; in other cases it has been necessary to use lime to raise the alkalinity and also to introduce a mixture to supply the material which is to be coagulated in the cracks.

In the case of small, concrete chambers, hemp and lead wool[3] have been calked into the cracks. Very satisfactory results were secured by this method in a concrete penstock, serving two small water turbines.

CHARLES HAYDOCK.[4]

[2] This method is to cut a groove, half an inch wide, and about three-fourths of an inch deep, along the crack with a chisel, and then calk the groove with hemp and asphaltum.

[3] Capt. Paul Hansen has also reported the successful calking of fine cracks with lead wool, without much preliminary preparation of the cracks.

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LEAD WOOL FOR CALKING CRACKS IN CONCRETE RESERVOIRS

The writer has had considerable experience in stopping leaks in concrete reservoirs, both in the bottoms and in the walls. Some of these leaks were caused by porous concrete of a very limited extent, while others were caused by shrinkage and settlement cracks.

In order to stop these leaks many schemes have been tried but the one that has given a great deal of satisfaction is as follows: The cracked or honey-combed portion is first cleaned, by means of chisels, of all loose and broken material. Great care is taken to do the job in a first-class manner. In case the crack is very small, then it has been the writer's practice to enlarge this crack to a depth of about 1 or $1\frac{1}{2}$ inches, making the enlargement in the form of a V. After the concrete has been prepared in the above manner, lead wool was driven into the crack or porous portion of the concrete by means of a suitable calking iron, very much in the same manner that the lead is calked in the joints of a cast iron pipe, using only a small portion of the lead wool at a time and continuing the process until the crack is completely filled even with the surface of the concrete on the two sides. Care must be exercised to see that the lead wool is well driven into place and forms a homogeneous mass instead of merely being shoved in haphazardly. When finished the crack appears exactly like a calked joint on a hub and spigot cast iron pipe. This method has been used on both inside and outside of structures so that the pressure may tend to either hold the lead wool in place or to push it out of the crack. Although this method of stopping leaks has been used for the last six or seven years no job has had to be done over a second time. Of course, unless the concrete is dense and of a good mixture the writer would not recommend this practice but with a good 1:2:4 mixture, properly mixed and placed, it has given a great deal of satisfaction at a very reasonable cost.

W. N. Jones.[5]

ASPHALT AND FELT MEMBRANE FOR CONCRETE RESERVOIR LININGS

In the Comments in the January issue of the Journal there is an invitation to discuss how leaks due to cracks in the bottom of a concrete reservoir may be stopped. It is said that "Confession

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is good for the soul," hence the following. The writer has had a very limited experience in repairing temperature or other irregular cracks in reservoir linings, but he has attempted to waterproof the so-called expansion joints usually employed in the construction of reservoir linings of any considerable area. His experience has taught him chiefly, however, "how not to do it."

In 1894 there were built for the water works of the city in which the writer lives, three small concrete-lined reservoirs of 12, 16 and 17 million gallons capacity and 30 to 49 feet maximum depth. The lining for these reservoirs was laid in alternate sections, 12 to 18 feet in width, extending up and down the slopes and across the reservoir bottoms. When the alternate sections were laid a beveled board was placed between adjacent slabs, which was removed later, leaving a tapering space about ½ inch wide on top and about 3 inches deep. This space was then filled with asphalt mastic and the entire reservoir surface covered with a mopped coat of hot asphalt.

The excavation for the smaller of these reservoirs was entirely in cement gravel and there has never been any appreciable leakage therefrom, probably due, principally, to the character of the earth foundation.

The linings of the two larger reservoirs were wrecked by a land slide before they had been in use for any considerable period, but so far as observed the water proofing of the joints was not a success.

In 1904 these reservoirs were relined under the direction of the writer. Two courses of concrete were laid with a membrane between made of hydrex felt coated with asphalt. The bottom course of concrete was laid without joints, but for the top course expansion joints were provided every 12 to 16 feet, extending up and down the slopes and on the bottom. Between the slabs two thicknesses of felt coated with asphalt were placed, against which the concrete was tamped, to provide for possible expansion or contraction of the lining.

A thorough system of under drains, leading to a sump outside of the dam forming one end of the basin, has enabled the engineers to observe the volume of leakage through the lining, which might occur. This, however, has been of small amount, in fact a negligible quantity.

Six years later the writer, as chief engineer, designed and built two other concrete lined reservoirs, of 50 and 75 million gallons capacity, and 30 feet maximum depth. The linings consisted of a

single layer of concrete, 5 to 10 inches in thickness, laid in sections 12 to 15 feet in width, extending up and down the slopes and across the bottom, the bottom sections varying from 20 to 40 feet in length. Under all joints a 5 by 9-inch concrete beam was built, faced with tarred felt coated with asphalt, the vertical joints between the slabs being faced with a similar layer of felt and asphalt. The entire surface of the concrete lining was covered with a well troweled finish coat composed of one volume of cement to two volumes of sand.

From an elaborate system of tile underdrains, centering in the gate chamber, a close measurement can be made of the volume of underdrainage due to defects in the lining, joints as well as the body of the concrete. After a trial of a few months the leakage was found to be excessive and subsequently an attempt was made to correct the difficulty by a treatment of the joints between the concrete slabs by applying to the surface of the lining a strip of burlap 6 inches wide with top and bottom heavily coated with asphalt. A few irregular cracks in the body of the lining were treated in a similar manner.

The volume of the leakage from these reservoirs still continues to be excessive and late examinations show that the burlap and asphalt treatment of the joints is defective, the burlap not adhering properly and the asphalt cracking in places along the edges of the burlap strip. The engineers now in charge plan additional repair work on these linings in the near future.

The experience of the writer, therefore, seems to point to the conclusion that for the effective waterproofing of a concrete lining for reservoirs, the use of a membrane of felt and asphalt has superior advantages and will insure thorough waterproofness. In the event such a membrane is used the presence of temperature or other cracks in the surface of the concrete is of minor importance. However, the matter of cost is often a controlling factor which must be considered.

D. D. Clarke.[6]

INDEX NUMBERS AND SCORING OF WATER SUPPLIES

The writer wishes to state that his discussion of Mr. Wolman's paper on this subject in the Journal of September, 1919, will deal largely with the adaptability of the index number suggested in this

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paper to the state sanitary control of water supplies. The writer has been very much interested in this paper since it suggests another method of comparing the sanitary quality of water supplies. It is apparent that the author thoroughly appreciates the difficulties attending the standardization of water supply control either by scoring or by index numbers. In the paper under discussion, he has attempted to eliminate certain fundamental factors which influence the safety of a water supply and has confined his discussion to the analytical control so far as it may relate to establishing index numbers. The application of the theory of probabilities for the purpose of determining an index number on water purification plant operation is most interesting. This mathematical theory has been applied to many other problems and has met with success in those instances where the proper basic data are available to justify its application. Assuming that the basic data given in the example contained in this paper, are sufficient to justify its application for this purpose, it provides a method of graphic comparison of the bacteriological results of water supplies which offers promise.

The use of the simplified index number by a state board of health for comparing the efficiency of water purification plants in a state such as Minnesota is to be questioned. It would appear to offer promise for the comparison of analytical results on some of the larger purification plants throughout the country that are properly constructed and under competent analytical supervision. It would be unfair to use the index method to draw comparisons on the efficiency of operation of plants in a given state unless the number of determinations was sufficient to justify the application of the theory of probabilities for this purpose, and a similar number of analytical determinations had been made during a given length of time on each plant and under similar operating conditions. Unfortunately, in the State of Minnesota, the number of bacteriological examinations made in connection with the operation of water purification plants varies widely, which would make it impossible to compute comparative index numbers on a fair basis. The writer feels that the variation in analytical methods, and especially, in the technique used at the various laboratories throughout a given state, might give occasion for concern when the results were being considered for comparison. The writer cannot be quite reconciled to depending exclusively on the analytical results when a comparison is made of one plant with another. The question of construc-

tion, operation and personnel is so fundamentally involved in the safety of the supply from a given water purification plant that comparison based entirely on analytical results might be very misleading.

As one simple example of faulty construction, it might be assumed that the filtration plant in question was provided with a by-pass, maintained for emergency purposes, through which water could be discharged around the plant and into the distribution system without treatment. It is a well-known fact that this defect in construction has already caused at least one typhoid fever epidemic. Such a defect is a potential danger which might not be indicated by analytical results. It would be unfair to give such a plant the same index number, so far as the safety of its effluent is concerned, as another plant that did not have such a defect in construction. Many examples could be given of faulty construction and possibly some of careless operation that might not be shown in the analytical findings and which would constitute definite hazards against the water supply. The writer feels that when comparisons are to be made of the safety of certain water supplies, the location, construction, operation and analytical results must be given consideration, otherwise a wrong opinion may result.

The index number system presented in this paper presents a new line of thought for further study, but the writer is of the opinion that any system that is devised for comparing the safety of water supplies should give recognition to all the important factors concerned.

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